50234

Patent Application

of

NORBERT WEBER

for

HYDRAULIC ACCUMULATOR, ESPECIALLY PISTON-TYPE ACCUMULATOR

Field of the Invention

The present invention relates to a hydraulic accumulator, especially a piston-type accumulator, having an accumulator housing and at least one gas chamber and a fluid chamber located therein separated from each other by a separating element, especially in the form of a piston.

Background of the Invention

One of the primary tasks of hydraulic accumulators is to hold specific volumes of pressurized fluids of a hydraulic system and to return them to the system again on demand. Hydraulic accumulators are generally piston accumulators, bladder accumulators, diaphragm accumulators, as well as weighted and spring-loaded accumulators. With these hydraulic accumulators, a plurality of tasks can be performed, such as energy storage, impact, vibration and pulsation damping, energy recovery, volumetric flow compensation, etc.

Valve control units generally provided with switching or directional control valves for managing the fluid flow to and from the hydraulic accumulator are used for operation and triggering of hydraulic accumulators. The hydraulic accumulator is generally connected to tubing with fluid lines which establish the fluid-carrying connection between the accumulator and the valve control unit. The disadvantages of the known solution, as can be readily obtained on the market in a

plurality of embodiments, involve tightness problems due to the increased number of connections between the hydraulic accumulator tubing and valve control unit and the added costs for the network of fluid lines. Especially under tight installation conditions, problems arise moreover in intelligently accommodating the plurality of components indicated and connecting them to each other so as to carry fluid. Since moreover different manufacturers are responsible for hydraulic accumulators, the tubing, and/or the valves of the valve control unit, on-site matching problems arise especially at the installation sites.

DE-A-39 41 241 discloses a piston accumulator, especially for drive slip-controlled brake systems, having a switching valve in the form of a charging valve provided in a space-saving design with its direction of motion transversely to the direction of motion of the accumulator piston, and of a structural part which encloses it as the separating element of the accumulator. The switching valve is configured in the valve block of the valve control unit of the piston accumulator by a control switch as the motion sensor for the structural part. As a result of the electrical control components of this known piston accumulator, it is complex to manufacture and thus expensive, and when the electrical components fail, operating shutdowns occur.

WO 02/40871 A2 discloses a generic hydraulic accumulator, especially a piston accumulator, having an accumulator housing with a gas chamber and a fluid chamber located therein separated from each other by a separating element. The fluid chamber can be charged with a pressure medium or at least partially emptied of the medium by a valve control unit having a switching valve. The switching valve is housed in the respective valve receptacle which can be moved from an open position into a closed position and vice versa in the direction of motion of the separating element in the form of a piston. The valve control unit in this known design is accommodated in a valve block which is independent of the housing. The valve block has another valve receptacle for another switching valve which performs another switching task. For modular use, the two indicated switching valves are made as identical parts. A complex line network between the hydraulic accumulator and valve control unit is avoided. Tightness or leakage problems as are common in the line network cannot occur at all. This hydraulic accumulator design is complex and thus expensive to produce. If electrically triggered valve systems are used, a

complex control configuration is necessary, leading to the above described disadvantages relative to operating reliability.

DE 101 61 475 A1 discloses another generic hydraulic accumulator solution with an accumulator-connecting block with ports for connecting the accumulator vessel of a hydraulic pump and a tank and with a 3-way valve for blocking and relieving the accumulator vessel. The blocking element of the 3-way valve is designed as a ball, with an operating shaft for stationary configuration of the centrically mounted blocking element, and with a circumferential surface which has apertures adjoining each respective sealing configuration which is assigned to each exit. In this known solution of an accumulator-connecting block, a sealed seat of the blocking element which is designed as a ball is ensured in each position of the valve. In the known solution, the accumulator-connecting block is spatially separated from the actual hydraulic accumulator.

Summary of the Invention

Objects of the present invention are to provide a hydraulic accumulator, which, while preserving the advantages in the prior art, requires altogether less installation space, which permits favorable fluid guidance of the fluid flows to be managed, and which improves the accumulator such that it is economical to produce and maintain and permits reliable operation, especially when used in suspension systems in vehicles, such as excavators, farm tractors, etc.

These objects are basically achieved by a hydraulic accumulator where one free end of the accumulator housing is closed off by a valve block having a ball valve which in its open position or closed position clears or blocks a fluid-carrying path from the interior of the accumulator housing to the exterior. The ball valve, by way of the valve block, is an integral component of the accumulator housing, and is accommodated in a space-saving design within the hydraulic accumulator solution. This arrangement also leads to a reduction of the free fluid paths and, therefore, to savings regarding tubing. With the solution of the present invention, the accumulator housing is closed off by a valve block having a ball valve, which thus forms a part of the pressure-bearing wall of the hydraulic accumulator, leading to a high-strength connection between the indicated components, the accumulator, and accumulator block.

Since this configuration can be built as a modular system, a wide range of applications can be covered by the components comprising the accumulator housing, valve block, and ball valve by the respective components being matched as identical modules to the fluid flows to be managed and their pressures.

If for actuation of the ball valve, electrical actuating means are omitted. A purely mechanical solution is achieved for the hydraulic accumulator, which is extremely reliable and which permits operation of the hydraulic accumulator in a very cost-effective way. If such hydraulic accumulator is used in a suspension system, a suspension accumulator is turned on by the fluid-carrying path to the hydraulic accumulator. In the open position, the ball valve is opened for springing of the suspension accumulator. The ball valve is diverted in its blocked position such that the suspension is blocked. A very simple, economical solution is then attained for triggering and controlling a suspension system as is used in particular in excavators, agricultural machinery, and the like. Thus, for example, the damping of the suspension system in a machine such as a wheel loader can be turned off by the integrated ball valve of the hydraulic accumulator as soon as tasks, such as picking up a load, are carried out with the bucket of the wheel loader. In this way, harmful oscillation processes for the wheel loader itself are avoided. As soon as transport tasks with or without a load, for example in roadway operation, arise, the suspension accumulator is turned on by the ball valve of the hydraulic accumulator. If the ball valve is actuated manually by an operator, in this area any electrical control components are eliminated so that the solution of the present invention can be very economically implemented and is reliable over the long term in operation.

Other objects, advantages and salient features of the present invention will become apparent from the following detailed description, which, taken in conjunction with the annexed drawings, discloses a preferred embodiment of the present invention.

Brief Description of the Drawings

Figure 1 is a schematic, not to scale, side elevational view of a hydraulic accumulator, partially in a section and partially in plan view, according to an embodiment of the present invention.

Detailed Description of the Invention

The hydraulic accumulator shown in Figure 1 is configured as a piston accumulator. It has an accumulator housing 10 with a gas chamber 12 and a fluid chamber 14 located therein. The gas chamber 12 is separated from the fluid chamber 14 by a separating element 16 in the form of a piston. With its sealing system the piston is guided so as to be longitudinally displaceable along the inner circumference of the accumulator housing 10 so that the ratio of gas chamber 12 to fluid chamber 14 is kept variable. To be able to store a larger amount of working gas (nitrogen gas) in the gas chamber 12, the piston element or separating element 16 is designed as a hollow part and inside has a corresponding recess 18. As viewed in the figure, the gas chamber 12 is sealed to the exterior on its right side by a flanged cover part 20 having a center hole with a gas valve body 22. Via gas valve body 22 the working gas, for example in the form of nitrogen gas, can be delivered into the gas chamber 12. The accumulator housing 10 is sealed gastight by the gas valve body 22. By the valve body 22, the amount of gas in the gas chamber 12 can be rechecked from time to time and can be added by a refill means (not shown).

The valve control unit 26 is connected to the free end of the accumulator housing 10 opposite valve body 22, and is in the form of a control unit or valve block 24. The valve control unit 26 has a ball valve 28 shown in its open position in the figure. In the opening position, the ball valve clears a fluid-carrying path 30 to the exterior from the inside of the accumulator housing 10, here in the form of a fluid chamber 14. In a ball valve closed position pivoted by 90° from the open position, it blocks the respective fluid-carrying path 30 fluid-tight. The passage direction of the ball valve 28 shown in the figure in its open position therefore extends along the transverse axis crosswise to the longitudinal axis 34 of the accumulator housing 10.

The pivot axis 36 of the blocking part 38 (plug) of the ball valve 28 is mounted off-center or offset from and parallel to the longitudinal axis 34 of the accumulator housing 10. The part 40 of the fluid-carrying path 30 within the valve block 24 runs or extends parallel and off-center or radially offset, as viewed in the figure essentially underneath, the longitudinal axis 34 of the accumulator housing 10. The blocking part (plug) 38 of the ball valve 28 is then configured diametrically opposite to this part 40 and relative to the longitudinal axis 34 of the accumulator housing. Another part 42 of the fluid-carrying path 30 is formed by a screwed part 44, running or extending transversely to the longitudinal axis 34 of the accumulator housing 10 and screwed into the valve block 24 on the outer circumferential side in the direction of the transverse axis 32.

To actuate the blocking part 38 of the ball valve 28, a handle 46 is used which has an actuating knob 48. The handle 46 has a pivot pin 50 with one free end engaging a groove-shaped recess 52 of the spherical blocking part 38. On its other free end, the pivot pin 50 is provided with an engagement screw 54 which holds the actuating knob 48 on the pivot pin 50 torsionally strong. For this torsionally strong connection, the actuating knob 48 is provided with a collar 56 positively enclosing the pivot pin 50 in this area. Otherwise, the pivot pin 50 is pivot-mounted by a flange-like widening 58 in the valve block 24. The pivot pin 50 between two edge-like segments 60 has a ring seal 62 to seal the interior of the valve block 24, especially with respect to the fluid-carrying path 30, relative to the surroundings.

On the front end of the valve block 24, the pivot pin 50 is provided with a stop ring 64 which interacts with a stop pin 66 fixed in the valve block 24 and extending essentially along the longitudinal axis 34 of the accumulator housing 10. In this way the blocking part 38 (plug) can be pivoted out of its open position, shown in the figure, by 90° into a blocking position (not detailed) by the actuating knob 48 and the pivot pin 50. This pivoting is limited by the stop ring 64 with the stop pin 66, in the same way as the possible pivot path when the blocking part 38 is being reset from its blocking position into the open position shown in the figure. These stop means are customary for ball valves so that they are not detailed here.

The accumulator housing 10 is designed preferably as a hollow cylindrical body. The valve block 24 meshes by a cylindrical extension 68 and by a screwed or externally threaded section 70 with one free end of the accumulator housing 10. This extension 68 widens flange-like and radially outside the accumulator housing 10. The flange-like edge 72 of the valve block 24 obtained in this way forms a stop surface for the front end of the accumulator housing 10 which is supported in this way on the edge 72 in the screwed-on state on the valve block 24. Furthermore, the cylindrical extension 68 tapers in the direction of the fluid chamber 14. In the area of the respective taper, a sealing part 74 seals the fluid chamber 14 against the exterior in this area.

The hydraulic accumulator is made as a piston accumulator, and can preferably be a component of a suspension system which is not detailed, with at least one suspension accumulator which is not detailed, for example in the form of a conventional bladder or diaphragm accumulator. This suspension accumulator which is not detailed is connected by the fluid-carrying path 30 to the screwed part 44 of the hydraulic accumulator either directly or by additional tubing from its fluid side. In the open position of the ball valve 28 shown in the figure, damping of the suspension can be connected, in which the fluid chamber 14 of the accumulator housing 10 is connected to the fluid side of the suspension accumulator. In this way, pressure surges by the damping action of the gas part of the suspension accumulator are effected. If the intention at this point is to eliminate this damping action of the suspension accumulator, the handle 46 is actuated by the actuating knob 48, and blocking part 38 (plug) of the ball valve 28 is moved into its position which blocks the fluid-carrying path 30. In this way, the suspension part of the suspension accumulator is diverted and accordingly the damping means is blocked. With the damping blocked, for example with the shovel of a wheel loader for which the described hydraulic accumulator is used, it is possible to drive into the earth, bulk material, or the like, without pitching movements unintentionally occurring on the vehicle in the form of a wheel loader itself. The latter clearly improves working with the shovel unit of a wheel loader. When the load is then picked up by the shovel, the suspension can be turned on again for transport away on a road or the like, by the ball valve 28 being moved in the reverse sequence, as described, by the actuating knob 48 into its open position shown in the figure, in which the damping part of the suspension accumulator is then turned on again by the fluid-carrying path 30.

The hydraulic accumulator of the present invention need not be limited to applications in wheel loaders, but can be used anywhere in suspension systems where damping devices such as suspension accumulators or the like are to be easily and reliably turned on and off, for example in the area of cultivating devices in agricultural machinery, if possible without complex control electronics. It is also within the scope of the present invention to replace the manually actuated handle 46 with an electrical actuating drive in the form of a servomotor to enable automatic triggering of the hydraulic accumulator, for example from a driver's compartment or the like. If in addition to the electrical actuating means, the handle 46 with the actuating knob 48 remains emergency actuation would in this way be possible if the electrical actuating components should fail.

In another embodiment of the hydraulic accumulator of the present invention which is not detailed, it can also be provided that the ball valve be mounted obliquely in the middle. The ball valve could also be mounted with its pivot axis offset by 90° relative to the illustrated installation position.

While one embodiment has been chosen to illustrate the invention, it will be understood by those skilled in the art that various changes and modifications can be made therein without departing from the scope of the invention as defined in the appended claims.

What is claimed is: